Stratégies d'assemblage de nanoparticules magnétiques

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The assembling of magnetic nanoparticles in films represents a very exciting and important challenge with regard to their high potential in the development of applications like sensors, high density magnetic storage or magneto-resistive devices. It is well argued that the key to successful applications is engineering the assembling of nanoparticles. Magnetic nanoparticles are featured by a single magnetic moment, and can be assimilated to elemental nanomagnets which may interact together through dipolar interactions. Therefore magnetic properties are strongly dependent on the spatial arrangement of nanoparticles.

Nanoparticles are also strongly size and shape dependent magnetic properties and their assembling by bottom up strategies requires non agglomerated NPs to be used as nanobuilding blocks. Recently, the thermal decomposition method opened new opportunities toward the structuration of iron oxide nanoparticles in films and in the fine control of their magnetic properties. The functionalization of nanoparticles is also an important point since it favours their stability in solution and their assembling on substrates through specific interactions.

We will present the assembling of functionalized nanoparticles with various sizes and shapes. Three different bottom-up approaches based on self assembling have been performed to control the nanostructure and the magnetic properties of the nanoparticle films. *(i)* The Langmuir-Blodgett (LB) technique led to the preparation of dense films with local ordering. Collective magnetic properties were favored and in plane dipolar interactions were dependent on the size and the spatial distribution of nanoparticles[1]. *(ii)* Multilayered films with controlled interlayer distances were prepared by the layer-by-layer (LbL) technique[2]. Dipolar interactions not only exist within the plane of NPs monolayers but also between nanoparticle layers and favor their antiparallel coupling. *(iii)* Self-assembled monolayers (SAMs) of organic molecules were used as molecular nanopatterns to prepare 2D nanoparticle assemblies with tunable magnetic properties as function of sizeable domains[3,4] and of the interparticle distance[5].

References

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